



## Ecological Studies of Mir Alam Lake With Reference to Water Quality

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### Nat. Env. & Poll. Tech.

Website: www.neptjournal.com

Received: 26-1-2013

Accepted: 9-2-2013

### Key Words:

Mir Alam Lake  
Ecological studies  
Water quality  
Algae

### ABSTRACT

The present investigation was undertaken to elucidate certain aspects of ecology of algae and physico-chemical characteristics of water with reference to water quality in Mir Alam lake. The lake provides a wide scope of identification of algal diversity existing in it. The lake is an important source of water for zoological park and, it is essential to assess the quality of water. The analysis of the physico-chemical characteristics indicates that the water is alkaline, and carbonates were recorded in high concentration. The dissolved oxygen is present in very low concentration, and organic matter, chlorides, phosphates and total hardness were present in high concentrations in the lake. The phytoplankton is dominated by Chlorophyceae. The species *Chlorella*, *Scenedesmus*, *Crucigenia*, *Pandorina*, *Euglena*, *Phacus* and *Trachelomonas* were dominant, and can be used as good indicators of water quality and pollution.

### INTRODUCTION

The ecological study of lakes, including physico-chemical factors is very important for determining development of algae and to know the strength of the pollution. The Ecological studies on lentic environments in India include the contributions of Zafar (1959), Munawar (1972), Jana (1973), Suxena & Venkateswarlu (1966), Dakshini & Soni (1979), Mohan & Zafar (1986), Pulla Reddy (2004), Pandey et al. (2004), Puttaiah et al. (2005), Kamath et al. (2006), Mathew & Deviprasad (2007), Ananthaiah (2010) and Srivastava (2010). Chemical factors are significantly responsible for the quality of water. The study of phytoplankton gives the number, variety and distribution of algae in a particular given habitat. It consists of diverse assemblage of nearly all major taxonomic groups. Many physico-chemical factors and factor complexes are responsible for the distribution and periodicity of algae. Many workers such as Philipose (1959), Sudha Rani (2004), Adhikary et al. (2010) and Das et al. (2010) worked out extensively relating them with various physico-chemical characteristics. Different physico-chemical properties along with biological variation help in assessing water quality.

### MATERIALS AND METHODS

Four sampling stations were selected from the Mir Alam lake. Station I is situated in south opposite to Muslim school. Station II is located 100 meter after Station I, Station III is located 100 meter after Station II, and Station IV is situated East of Mir Alam lake.

Water samples from the surface were collected at all the

sampling stations at monthly intervals for a period of one year. The samples were analysed on the same day in the laboratory for different physico-chemical parameters following the standard methods (APHA 1995).

For phytoplankton 1 litre of water samples were collected from the four sampling stations of the lake and kept in the sedimentation column after adding 2-3 mL of 4% formaldehyde solution. The material was used for frequency measurement and identification of species. For frequency measurement of different species of algae at each station, the drop method of Pearsall et al. (1946) was followed.

### RESULTS AND DISCUSSION

In Mir Alam lake the water was alkaline with an average pH of 9.00. Carbonates ranged from 12.0 to 96.02 mg/L. Bicarbonates were present in an average range of 250.17-854.25 mg/L. Chlorides ranged from 461.5-710.0 mg/L. Dissolved oxygen was present in an average range of 0.0-0.8 mg/L. Organic matter ranged from 2.0-18.0 mg/L. Silicates were in the range of 0.0-38.2 mg/L, and nitrites of 0.0-35 mg/L. Total hardness ranged from 90-530 mg/L with Ca and Mg 36-176 mg/L and 68.13-80.29 mg/L respectively. Sulphates ranged from 0.06-53 mg/L, and phosphates 2.6-25.6 mg/L.

Mainly four groups of planktonic algae were recorded in the lake. They were Chlorophyceae, Cyanophyceae, Bacillariophyceae and Euglenophyceae. At all the stations Chlorophyceae was dominant and occupied the first position. Bacillariophyceae occupied the second position at all the stations. At Stations I, III and IV Cyanophyceae, and at Station II Euglenophyceae occupied the third position.

In the present lake Chlorophyceae was chiefly represented by Chlorococcales. Station II exhibited much higher percentage of green algae as compared to other stations, which favour high values of organic matter and very low dissolved oxygen. There are many opinions regarding the distribution of this group. According to Seenayya (1971) high bicarbonate content was responsible for their presence. Iyengar (1933) and Philipose (1960) are of the opinion that the presence of nitrate and phosphates may be the other reason. In the present investigation, Chlorophyceae was found to be dominant group at all the stations. Volvocales (mainly *Pandorina morum*) were present in considerable number at Stations I and III. The species identified at different stations and the total numbers of common species are given in (Table 2). At Station I, the highest peaks were observed during June, and the lowest during February. At Station III the Chlorophycean members were present in very low numbers during winter. At Station IV, the highest numbers of these algae were recorded during November-October. The peaks were mainly due to *Scenedesmus dimorphus*, *S. bijugatus* and *S. quadricauda* var. *maxima*, and these species were present throughout the period of investigation. *Coelastrum cambricum*, *Crucigenia rectangularis* and *Chlorella vulgaris* were found in summer peak only. The highest peaks were mainly due to *Scenedesmus quadricauda*, var. *longispina* and *S. dimorphus*, whereas *Pandorina morum* and *S. quadricauda* var. *maxima* constituted the second peak. The peaks were due to the presence of *Pandorina morum* and *Scenedesmus quadricauda* var. *quadrispina*.

Sampath Kumar (1977) and Roy (1955) have also emphasized the importance of temperature in the periodicity of Chlorococcales. The present study is in conformity with their findings since Chlorococcales developed abundantly in summer at all the stations. Similar observations were made by Misra et al. (2009), Jawale et al. (2009), Dhande & Jawale (2009). In the present lake the *Coelastrum* and *Chlorella* species were very common throughout the year. Gonzalves & Joshi (1946) and Venkateswarlu (1969) have reported that high concentrations of dissolved oxygen are favourable for the development of Chlorococcales. Venkateswarlu (1969) also pointed out that high concentrations of nitrites and low dissolved oxygen appear to be unfavourable for the development of these algae. This is also evident in the present study especially at Station II where the dissolved oxygen was comparatively low and nitrites were more.

Blue-green algae occupy third place in their dominance at all the stations. Station III recorded high percentage of blue-greens than the other stations. Station III also recorded high concentration of oxidizable organic matter and low concentration of dissolved oxygen. At Station III, blue-greens attained maximum numbers in June-July and minimum dur-

ing January-February. In general, the high numbers were always during summer months in high temperature, and low during winter months, when the temperatures were low. From the data, it is quite evident that the blue-greens attain maximum number during summer months when the water temperature and organic matter were high, and minimum in winter months when the temperature and organic matter were low. Many investigators stressed the importance of temperature and organic matter in the periodicity of blue green algae (Chakrabarthy et al. 1967, Venkateswarlu 1969, de Smet & Evans 1972, Sampath Kumar 1977). In Mir Alam lake, water temperature and blue green algae showed a direct relationship in their monthly fluctuations. Reddy & Venkateswarlu (1987), Pulla Reddy (2004), Ananthaiah (2010) and Bhakta et al. (2010) have observed the luxuriant growth of blue greens in waters low in dissolved oxygen. Similar results were also obtained in the present data and are clearly indicated at Station III. Here, the low dissolved oxygen concentrations were associated with high number of blue-greens. In general, the dissolved oxygen values were decreased from Station III and the number of blue-greens increased gradually. Cyanophyceae showed a direct relationship with organic matter at all the stations. From the above data, it is evident that Cyanophycean members prefer high temperature, organic matter rich media and survive well even in oxygen deficient waters which are not so suitable for the members of other algal groups.

Diatoms were one of the most abundant and diversified groups of phytoplankton. In the present study, diatoms occupied second position. But, they differed in terms of abundance at different stations.

In the present investigation at all the stations, the species of *Euglena acus*, *E. polymorpha*, *E. hiemalis*, *E. tripteris*, *E. proxima*, *Phacus longicauda*, *P. circumflexus*, *P. tortus*, *P. brachykentron*, *P. indicus*, *P. helikoidis*, *Lepocinclis fusiformis*, *Trachelomonas fluviatilis*, *T. pulcherima*, *T. intermedia* and *T. hispida* were present. Compared to the other groups of algae, this group was observed high in numbers and more number of species at all the stations during summer months. The mildly polluted Station II harboured more number of these flagellates than the other stations. In the present study high pH (8.9-9.3) and temperature 24°C favoured the development of Euglenophyceae population. Kumar et al. (1974) observed that the blue greens and Euglenoid-flagellates are mostly associated with organically rich effluents low in dissolved oxygen. This is also obvious in the present lake especially at Stations II and III.

## WATER QUALITY

The average values of the important physico-chemical variables of the water body studied along with the standards stipulated by Rawal et al. (1978), WHO (1971) and ISI (1982)

Table 1: Comparison of the present data with ISI, WHO and Rawal's standards.

Parameters	Mir Alam Lake				ISI 1982	WHO1971	Rawal's data 1978	
	Station-I	Station-II	Station-III	Station-IV			Permissible Limit	Excessive Limit
pH	9.13	8.93	9.08	8.85	6.5-8.5	7.0-8.5	6.5-8.5	6.5-8.5
CO <sub>3</sub> <sup>2-</sup>	37.51	35.86	39.01	41.01	-	-	-	-
HCO <sub>3</sub> <sup>-</sup>	685.18	679.54	687.98	648.32	-	-	-	-
Cl <sup>-</sup>	625.39	590.78	579.83	579.83	-	200	250	600
D.O.	0.42	0.27	0.30	0.37	6.0	3.0	3.0	-
Organic matter	5.21	7.83	8.17	5.33	-	-	-	-
Total hardness	284.17	263.50	289.17	263.00	300	100	150	500
Ca <sup>2+</sup>	108.33	85.73	75.53	72.67	200	75	75	200
Mg <sup>2+</sup>	7.70	13.63	24.41	24.49	100	30 - 150	50	150
PO <sub>4</sub> <sup>3-</sup>	11.73	11.20	11.78	11.13	-	-	2.0	5.0
NO <sub>2</sub> <sup>-</sup>	10.22	10.59	11.62	12.47	-	-	1.0	-

Table 2: Common algal species in Mir Alam lake.

<i>Pandorina morum</i>	<i>Scenedesmus quadricauda</i> var. <i>longispina</i>
<i>Chlorella vulgaris</i>	<i>Coelastrum microporum</i>
<i>Scenedesmus quadricauda</i> var. <i>maximum</i>	<i>Trachelomonas intermedia</i>
<i>Crucigenia tetrapedia</i>	<i>Phacus circumflexus</i>
<i>Scenedesmus dimorphus</i>	<i>Phacus indicus</i>
<i>Actinastrum hantzchii</i>	<i>Phacus brackhykenton</i>
<i>Trachelomonas pulcherima</i>	<i>Oscillatoria subbrevis</i>
<i>Oscillatoria formosa</i>	<i>Oscillatoria chlorina</i>
<i>Euglena acus</i>	<i>Oscillatoria chalybea</i>
<i>Phacus tortus</i>	<i>Oscillatoria tenuis</i>
<i>Phacus longicauda</i>	<i>Euglena hiemalis</i>
<i>Phacus helikoidis</i>	<i>Euglena tripteris</i>
<i>Cyclotella meneghiniana</i>	<i>Euglena proxima</i> var. <i>amphorae</i>
<i>Navicula rhynchocephala</i>	<i>Gomphonema montanum</i>

are given in Table 1. From the comparison, it is clear that the water in Mir Alam lake can be termed 'polluted' because all the factors are above the permissible limits.

In the present investigation, both the physico-chemical and biological parameters have been taken into account for assessing the quality of water and pollution. Among the biological parameters the algal flora has been used as an important tool in lake study. The species observed at all the stations belongs to polluted water organisms.

**CONCLUSION**

Both physico-chemical and phycological data analysed in the Mir Alam lake, indicate that the water is polluted and the quality of water is deteriorated. Hence, it cannot be used for various purposes, such as drinking, domestic, and recreation, etc.

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